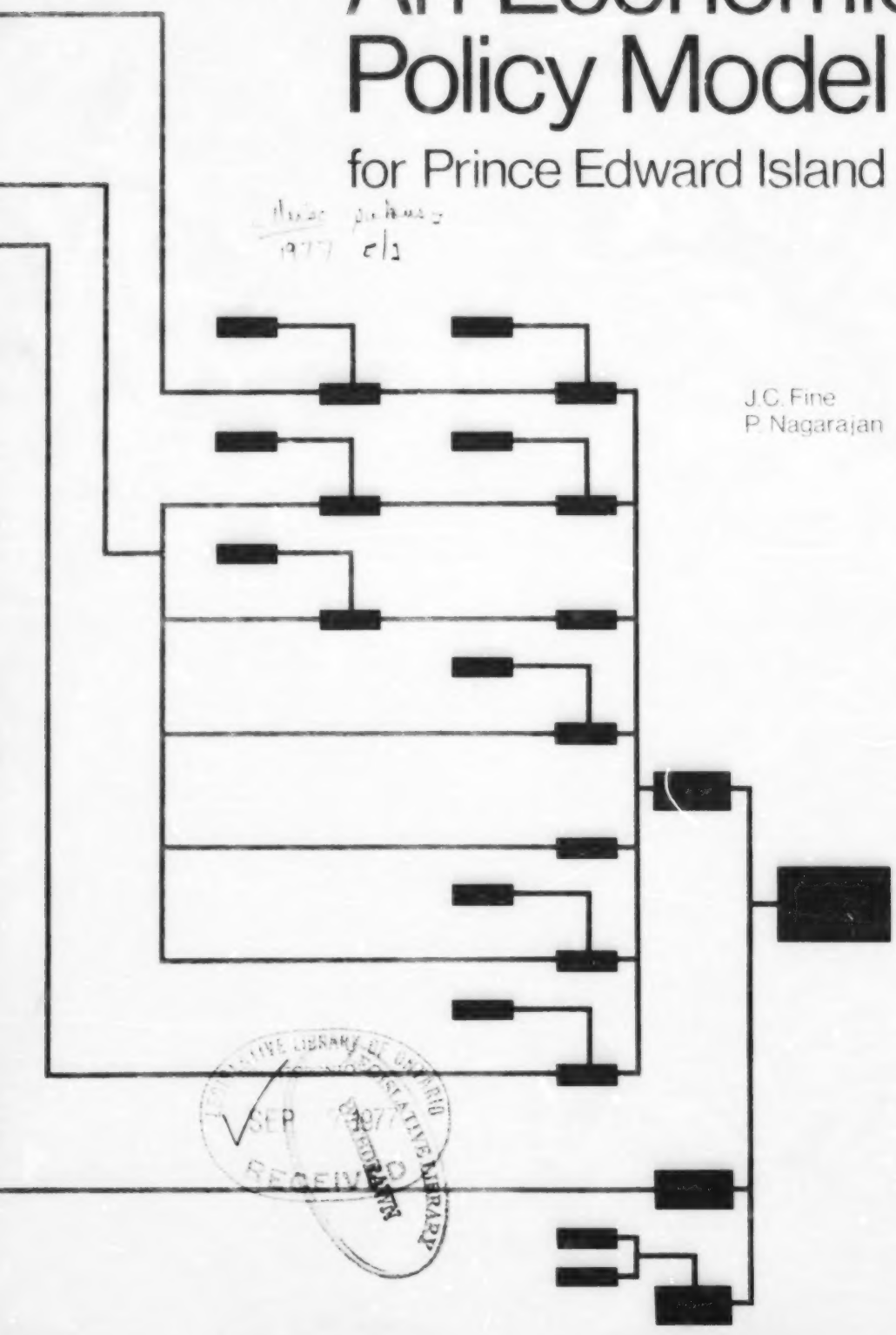
An Economic Policy Model

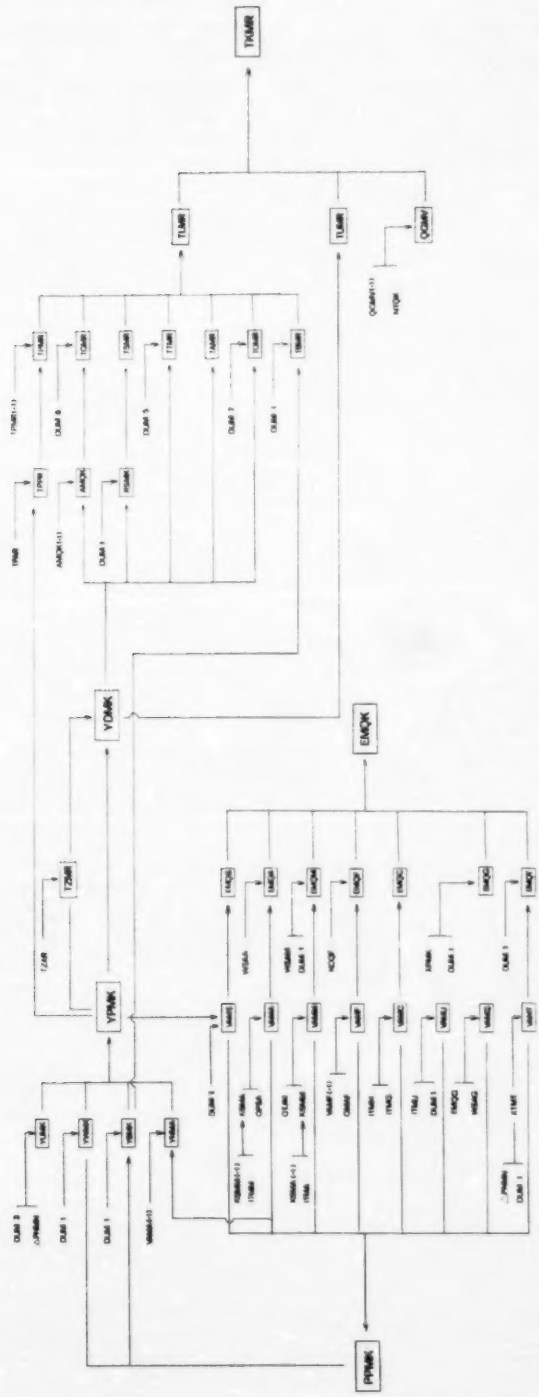
for Prince Edward Island

J.C. Fine
P. Nagarajan



SEP 1977
RECEIVED

101-06970/



Return
Dept

1977

CONTENTS

Foreword 3
Introduction 4
Methodology 6
The Structure of the Model: Concepts and Observations 9
Impact Analysis 23
Policy Implications 25
References:
Appendix A: Model Variables 28
Appendix B: Computer Formulation of the Model 30
Appendix C: Simulation Results 32
Appendix D: Reduced Form Matrix 42

FOREWORD

This monograph contains an economic policy model prepared for the Government of Prince Edward Island.

We wish to express our appreciation to Dr. J. Maloney, Minister of Development, Dr. T. Connor, Deputy Minister of Development, and Mr. H. G. Fairfield, former Deputy Minister of Development for their guidance and support. Our work has benefited from the comments and criticism of Mr. Peter Gunther, Senior Economist, Atlantic Provinces Economic Council, Dr. Neil Swan, Economic Council of Canada, and Mr. Nate Laurie, Conference Board in Canada, as well as many other colleagues and associates too numerous to mention individually. Dr. Oscar Perez de Tagle and Mr. Milton Ellis assisted in the collection and tabulation of the data. Mr. Jackson Siu prepared the charts and diagrams and assisted in simulating the model. Mrs. Marilyn MacLean typed the text.

The views and opinions expressed in this report are our own and do not necessarily reflect those held by the Government of P.E.I., its agencies or Departments, or any of the people who have assisted us in its preparation.

P. Nagarajan, Ph.D.
Associate Professor and Chairman
Department of Economics
University of Prince Edward Island

Jeffrey C. Fine
Senior Economist
Department of Development
Government of Prince Edward Island

I. INTRODUCTION

The construction of this model of the P.E.I. economy was undertaken with several objectives in mind. First, there was the task of analyzing the provincial economy, of isolating important relationships and tracing significant changes in its structure. Secondly, this information would then become available to decision makers for testing policy options. The impact of various measures on the province's economy would be "simulated", thereby furnishing policy makers with additional information concerning the economic consequences of their decisions. Finally, the model could be used to forecast the probable effect on the province of changes in the Canadian or world economy. Of these three objectives, the first two were particularly important in the development of the model. The third, economic forecasting, lies within the general capacity of the present model. However, some additional work will be needed before it can be utilized for this purpose.

This model has been developed in the context of a firm commitment by the provincial and federal governments to vigorous and stable economic development. The major instrument of public policy has been the Comprehensive Fifteen Year Federal/Provincial Development Plan, started in 1969 and now in the second of its three major phases. The Development Plan symbolizes a commitment to alter the structure of the provincial economy; to raise productivity; and to promote industrial development. The role of the public sector is to provide greater opportunity for social and economic advancement through investments in economic and social infrastructure; by easing access to capital; and by the provision of such supportive services as market research and agricultural extension. The active agent for change is the individual entrepreneur or company in the private sector.

In addition to investments in social and economic infrastructure under the Development Plan, both governments, through a variety of agencies and departments, have sponsored other programs promoting industrial development. Perhaps of even greater consequence in terms of its impact on incomes and general well-being has been the "quiet revolution" in the field of social policy. Prince Edward Islanders benefit from such programs as medical care that did not exist when the Plan was started in 1969. These programs and others under the Canada Assistance Plan, the Unemployment Insurance Act, and the Hospital and Diagnostic Services Act provide Islanders with a range of services that could not be supported by the provincial economy on its own. They have had a substantial impact on the province's development prospects.*

The model provides a broad assessment of the extent to which the structure of the economy has changed at the mid-way point of the Development Plan. The structure of the model also offers an interesting insight into the role that the provincial government can realistically expect to play in influencing economic development and in managing its own economy.

By providing the basis for exploring the relationships among the leading variables in the provincial economy, the model enables policy makers to assess the impact of various policies and programs on economic development. A useful device are the "impact multipliers" that can be used to guage the effect of changes in such variables as investment or prices on output, income, employment and government revenue. Our choice of variables has been partially influenced by our interpretation of the province's economic objectives and by the policy instruments available to the provincial government. An overall qualification to our choice of variables has been that they can be measured. In summary the model's design presupposes that there is little point in analyzing the provincial economy using factors that cannot be measured or that cannot be influenced, directly or indirectly, by the provincial government.

---

* Fine, J.C. and Nagarajan, P. *The Impact of Unemployment Insurance on the Economy of Prince Edward Island*. P.E.I. Studies in Economics, No. 6 UPEI, November 1976.

The model can also provide a sound basis for reliable forecasts that would reduce the degree of uncertainty confronting decision makers. It has been designed so that forecasts made at the national level can be incorporated and used in turn to estimate their probable impact on the province.

Data constraints have also been important in determining the structure of the model. We could not, for example, adopt a conventional Keynesian approach to estimating Gross Provincial Product since there are no personal expenditure data available on a provincial basis. We have attempted to adhere to a general rule of not specifying relationships that would necessitate special data collection procedures since P.E.I. does not possess a statistical or data gathering agency at the present time. The model has been designed to run on published information that is readily available from official sources. With two exceptions, this guideline has been maintained successfully. First, the inclusion of tourism as a separate sector required the use of special survey data of the provincial Department of Tourism to obtain estimates of value added and employment. Secondly, the capital stock figures for agriculture and manufacturing have not yet been formally released by Statistics Canada.

This model contains several novel features:

a) It is a dynamic simulation model that generates direct and indirect impact multipliers.

b) Tourism and government have been included as separate economic sectors.

c) The various revenues of the provincial government have been included.

d) Employment in each major sector of the provincial economy has been incorporated as a target variable.

Economic analysis and model building is a continuing activity. We have been fortunate in being able to draw upon the earlier economic model of P.E.I. that was completed in 1971.* This pioneering effort has provided us with a yardstick for assessing the reliability of several economic relationships and for measuring overall, changes in economic structure that have taken place over the last five years. The present model has been developed with a foreknowledge that policy priorities and policy instruments will change over the next few years. We also expect that some sectoral planners may find the provincial level variables too aggregated for their own immediate purposes. The model therefore has been flexibly designed with a view towards continuous refinement and change. Subject to the two overriding conditions of data availability and theoretical validity, it can be altered to include more disaggregated variables or alternatively expanded to encompass a broader range of policy instruments and options.

---

* Schwartz, F. *An Econometric Model of P.E.I.* Office of the Economic Advisor, Charlottetown, P.E.I. Jan. 1972.

II. METHODOLOGY

The model was developed in two stages:

a) Specification of the structural equations

b) Estimation of the reduced form

The structural equations were specified in the following form:

$$Yit = a_{ot} + b_{it}x_{it} \cdots\cdots + b_{nt}x_{nt} + U_{it}$$

where

Y_{it} - the dependent variable

a_{ot} - the vertical intercept

b_{kt} - the structural coefficient of Kth independent variable

X_{kt} - the Kth independent variable

U_{it} - the disturbance or error term

The statistical method used is ordinary least squares (OLS) which binds the dependent or endogenous variable (Y) to the independent or exogenous variable(s) (X) in the equation. The tests used to measure the size and significance of relationships are:

a) the "t" statistic

b) the adjusted coefficient of multiple determination, $\bar{R}^2$

c) the Durbin-Watson statistic

d) the standard error of regression, SER

The "t" value measures the statistical significance of the relationship between the independent variable and the dependent variable. By dividing the estimated coefficient (b) of each variable by its standard error, a ratio is formed which has a Student's "t" distribution under the null hypothesis that the true value of the coeficient being estimated is zero. If the absolute value of the ratio is greater than the table value of "t" the hypothesis of a zero coefficient is rejected, and the coefficient is termed statistically significant. The $\bar{R}^2$, or adjusted coefficient of multiple determination, measures the percentage of variance explained by variations in the independent variables as a group. Time series analysis assumes serial independence of the residual term (u). The Durbin-Watson statistic is used to test for the presence of autocorrelated residuals. By conventional test, a Durbin-Watson value close to 2 would denote a lack of autocorrelation. The standard error of the regression (SER) indicates a confidence interval for the values forecast by a particular equation. The predicted value of the dependent variable (Y) would fall within the mean plus or minus twice the value of the SER 95% of the time.

In order to observe the effect of each independent variable on the system as a whole rather than on the specific dependent variable to which it is linked in a particular equation, we proceed in the second stage to derive the reduced form equations from the set of structural equations. The original system of structural equations is solved to express

the endogenous variables as functions of all of the exogenous variables in the model. Since each reduced form equation contains only one endogenous variable, the reduced form coefficients represent the total indirect and direct effects of the exogenous variables on the dependent variable. For example, according to its structural formulation, employment in agriculture is a function of two independent variables, the agricultural wage rate and agriculture value added. However, agriculture value added is a function of three other variables: capital stock in agriculture, farm output prices and a time trend. The capital stock variable is estimated in turn from agriculture investment and from total capital stock in the previous year. The estimation of agricultural employment in the reduced form equation would be based on this much broader set of relationships rather than on the two variables appearing directly in the structural equation. The estimates of reduced form parameters are called "impact multipliers", since they measure the direct and indirect impacts of changes in the exogenous variable on the endogenous variables in the model. The reduced form equations are useful for simulating policy measures and for forecasting, but not for analyzing how the various components of the economic system actually function.

A four character name or mnemonic was designated for each variable in the model. The first two characters identify the economic variable itself, e.g. KS for capital stock, TG for gasoline tax, TS for sales tax, etc. The third character indicates the unit of measurement, e.g. M for current dollars, J for index values, etc. The fourth and last character indicates the specific sector of the economy, e.g. A for Agriculture, G for Government, etc. Thus the character VAMA stands for value added in agriculture measured in current dollars.

1 2
/V/A/ - economic variable - value added

3
/M/ - unit of measure - current dollars

4
/A/ - economic sector - agriculture

The symbol (-1) after the mnemonic indicates the value of the variable in the previous year. The variables are listed alphabetically in Appendix A.

To illustrate the procedure for interpreting the format in which the model is presented, we offer two examples of equations as they appear in the model.

(4) VAMG ≡ EMQG* WSAG

This first equation is a definition that appears as equation number four in the model. It states that value added in the government sector (measured in thousands of current dollars) is defined as the total number of government employees times their average yearly salary.

(21)	EMQA	=	11149	+ .03 VAMA	- 3529 WSMA	$\bar{R}^2$	D.W.	SER
			(.18)	(.67)	(-2.54)	.59	2.44	528

This equation is termed behavioral and appears as structural equation number 21 in the model. It expresses employment in agriculture (total number) as the function of agriculture value added (thousands of current dollars), and the average hourly wage in agriculture (dollars). The value of the constant, the vertical intercept, is 11,149 people. Assuming that all other factors remain constant, a rise of $1 million in agriculture value added will increase total employment by 30. On the other hand, a one dollar increase in the hourly wage rate will lead - all other factors remaining constant - to a drop in employment of 3,528. The "t" values appear in parentheses under the coefficients and indicate that the coefficient of the wage rate variable is significant at the .05 level. The $\bar{R}^2$ figure of .59 states that the two independent variables together explain 59% of the variance in agricultural employment. The Durbin-Watson statistic of 2.44 suggests the absence of serial correlation. The SER statistic of 528 is low relative to the mean values of the dependent variable (EMQA) and implies that the employment value estimated by the equation will be fairly reliable.

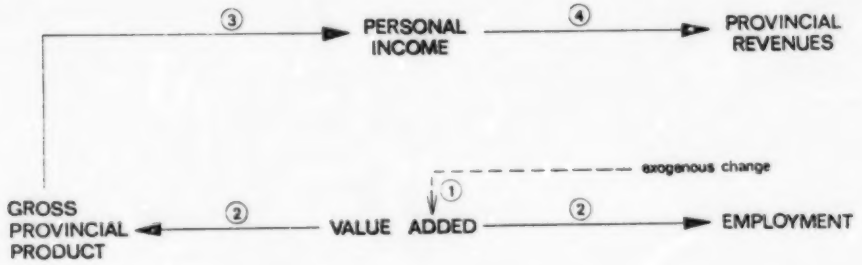
The value of "t" that establishes the statistical significance of a coefficient at a specific level declines as the number of observations is increased. However, in a situation where annual data are being used, each additional observation adds one year to the historical time series. This procedure tends to reduce the reliability of the structural coefficient for forecasting purposes.* It was decided to estimate the structural equations for the period 1966-74 even though the number of "degrees of freedom" would be eight or less. The model was also estimated for the period 1961-74 and no major differences were apparent, even though the values of the structural coefficients did differ to some extent, as one would have anticipated. For this reason, we have accepted "t" values of two or more as an indication of statistical significance at the .05 level.

---

* The problem is less acute in the case of models using quarterly data since each year added to the historical time series provides four more observations.

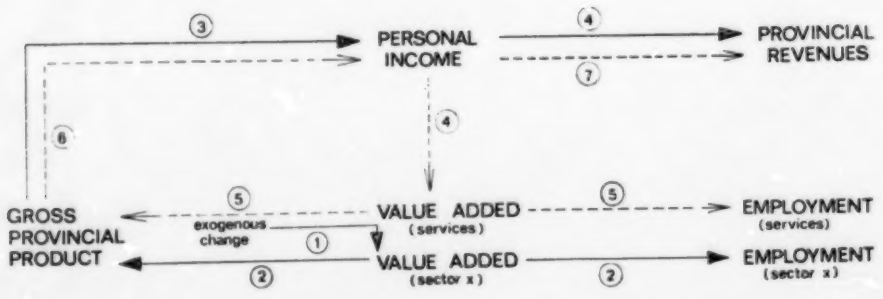
III. THE STRUCTURE OF THE MODEL: CONCEPTS AND OBSERVATIONS

The model's thirty-two behavioral and eight definitional equations are contained in four major blocks or sub-models: value added or product; personal income; provincial government revenue; and employment. The value added and employment blocks are disaggregated further into eight and seven sectors respectively. The revenue block comprises nine different types of taxes, fees and intergovernment transfers. Personal income incorporates income flows from five different sources.* This four block structure reflects provincial concern over the impact of various policies and external developments on employment, income, and government revenues in the province. The regional perspective of the model is implicit in the sequence of causal relationships among the four blocks.

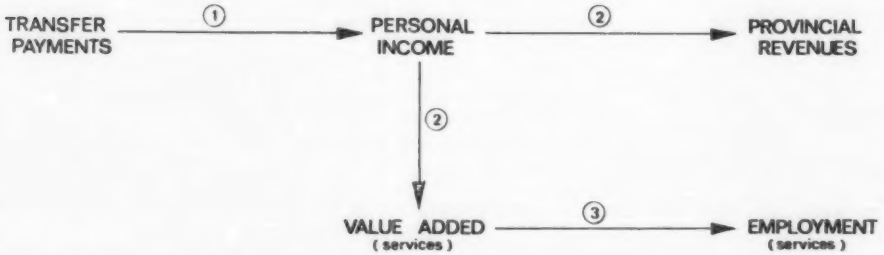


Value added is a function of changes in the exogenous variables, i.e. in factors not determined by the model. These movements affect employment and personal income. Changes in personal income in turn affect provincial government revenues. In addition to this general pattern of causation, other exogenous factors are also inserted at various points to explain changes in the endogenous variables i.e. in those variables whose value is determined within the model itself.

The performance of each individual sector of the economy may also be affected by changes in the other sectors. In the absence of a provincial input-output matrix that is customarily used to measure these inter-sectoral linkages, the model utilizes a unique "feedback" mechanism whereby changes in the value added of one particular sector indirectly affect value added in the services sector through changes in personal income. The mechanism operates in the following sequence:



The model is able to capture most inter-sectoral movements within the economy because value added in "services" is defined as the difference between Gross Provincial Product and the total value added of the other seven sectors; it accounts by value for over 50% of the province's annual output of goods and services. The services sector also captures the effect of changes in personal income transfers (Unemployment Insurance, pensions, etc.) on provincial output and employment through subsequent shifts in total personal income and in the value added in services.



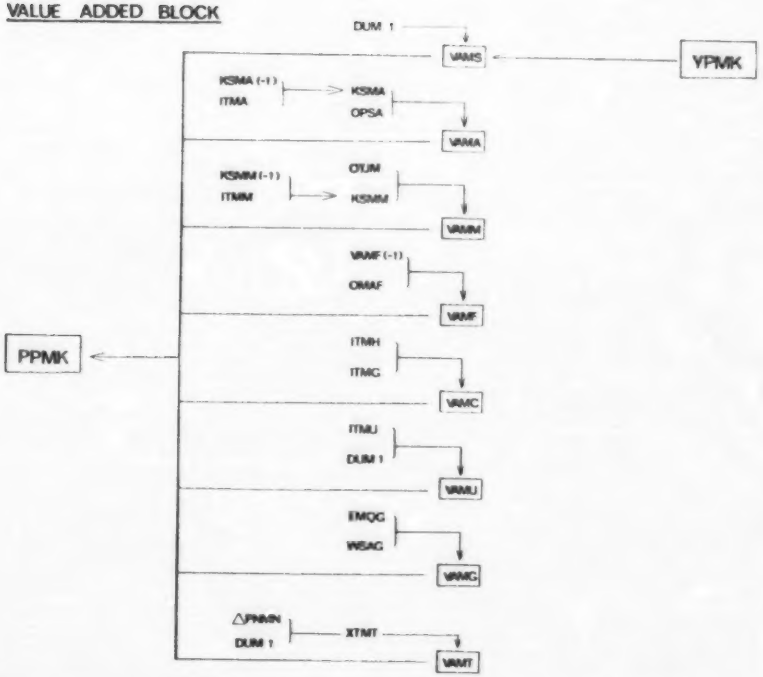
A unique feature of the model is its incorporation of employment as an endogenous variable, i.e. as a variable determined within the model itself. Most other models regard employment as a factor of production that together with capital determines total output. This supply oriented approach, however, does not correspond to the provincial perspective of employment as a function of changes in the value of output. The latter is seen as a major determinant of the market demand for labor. Our somewhat unconventional approach enables the model to measure the impact of government policies and programs on employment in different sectors of the economy. The data, however, should be treated with circumspection since the measurement of employment at the sectoral level is still subject to a wide margin of error.

In several sectors, the endogenous variable has been affected by changes in government policies or by irregular events whose impact cannot be measured directly. There are, moreover, longer term trends in technology, social structure, attitudes, etc. that affect economic behavior. They cannot, however, be measured discretely in a manner compatible with the model's methodology. These longer term trends therefore are ascribed to "Time". The influence of non-recurring and time trend factors are incorporated within the model through the use of dummy variables.

The model, in its entirety, is presented in schematic form in the attached chart.

The structural equations reveal several distinctive features of the P.E.I. economy. The model suggests that externally determined prices in agriculture, manufacturing and fishery play an important role in determining value added, and consequently, employment in these sectors. On the other hand, changes in value added could not be explained by variations in physical output. Construction emerges as a strategic sector where the provincial government can, in the short term, influence value added and employment through investment in housing and its own capital expenditure program. These two features hold serious implications for the management of short term counter-cyclical policies and longer term developmental policies. Another feature is the prominence of primary and tertiary sectors and the relative insignificance of secondary industry in the province. The long term decline in agriculture employment has been balanced by a rapid expansion in services and government rather than by major growth in secondary manufacturing. The structural equations portray an economy that is heavily dependent on services and primary industry and unusually sensitive to external price movements.

VALUE ADDED BLOCK



STRUCTURAL EQUATIONS

				$\bar{R}^2$	DW	SER
(5)	PPMK	≡	VAMA + VAMM + VAMC + VAMU + VAMF + VAMT + VAMG + VAMS			
(3)	VAMT	≡	XTMT * VGPT			
(4)	VAMG	≡	EMQG * WSAG			
(14)	VAMA	=	-36119 + 160.6 OPJA + .60 $\hat{KSMA}$ - 3099 DUM1 (-.89) (3.74) (.97) (-1.22)	.96	2.47	2530
(15)	VAMM	=	-8922 + .17 $\hat{KSMM}$ + 76 OTJM (.60) (2.20)	.97	1.38	1080
(16)	VAMC	=	4065 + .49 ITMH + .35 ITMG (4.01) (21.10) (7.03)	.99	2.20	744
(17)	VAMU	=	.06 + .07 ITMU + 413 DUM1 (.0001) (.97) (5.37)	.94	2.04	324
(18)	VAMF	=	1868 + .16 VAMF (-1) + 10423 OMAF (1.09) (.51) (2.47)	.75	2.49	985
(19)	XTMT	=	-8515 + .0006 ΔPNMN + 1603 DUM1 (-6.95) (7.63) (9.82)	.99	2.56	670
(20)	VAMS	=	22002 + .25 YPMK + 6438 DUM1 (1.92) (2.26) (2.08)	.98	1.60	5750
(a)	$\hat{KSMA}$	=	.86 ITMA + .99 KSMA (-1) (.88) (13.14)	.91	1.43	5370
(b)	$\hat{KSMM}$	=	2.93 ITMM + .78 KSMM (-1) (4.90) (11.14)	.98	1.53	1160

VARIABLES

DUM I . time trend
EMQG . government employment, thousands
ITMA . investment in agriculture, thousands of dollars
ITMG . government and institutional investment, thousands of dollars
ITMH . investment in housing, thousands of dollars
ITMM . investment in manufacturing, thousands of dollars
ITMU . investment in utilities, thousands of dollars
KSMA . capital stock in agriculture, thousands of dollars
KSMM . capital stock in manufacturing, thousands of dollars
OMAF . average price per pound of molluscs
OPJA . Eastern Canada agriculture price index, 1961 equals 100
OTJM . Canadian wholesale price index for manufactured goods, 1935-39 equals 100
PNMN . gross national product, thousands of dollars
VAMA . value added in agriculture, thousands of dollars
VAMC . value added in construction, thousands of dollars
VAMF . value added in fisheries, thousands of dollars
VAMG . value added in government, thousands of dollars
VAMM . value added in manufacturing, thousands of dollars
VAMS . value added in services, thousands of dollars
VAMT . value added in tourism, thousands of dollars
VAMU . value added in utilities, thousands of dollars
VXPT . proportion of tourist expenditure going to wages, profits and indirect taxes
XTMT . total tourist expenditure, thousands of dollars

VALUE ADDED BLOCK

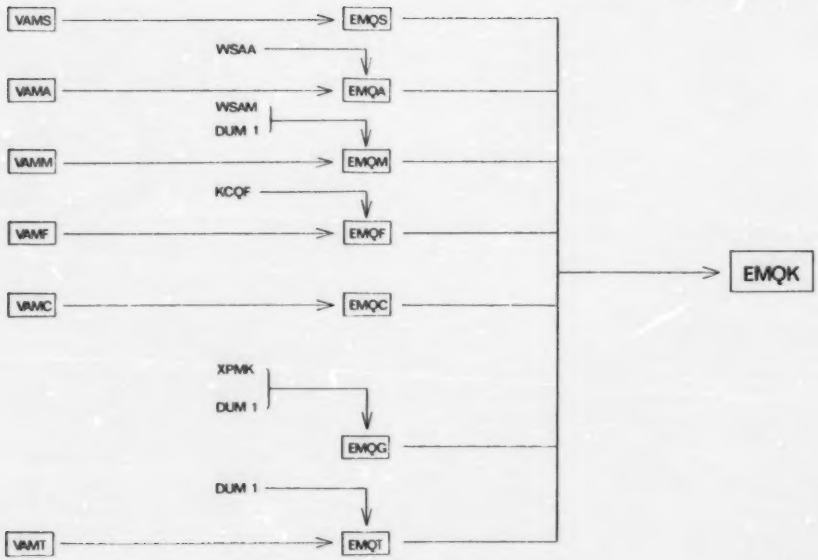
The value added or product block consists of the value added of eight sectors that together comprise the Gross Provincial Product of P.E.I. Value added in the services sector is the residual or difference between Gross Provincial Product and total value added of the other seven sectors. Investment variables have been inserted directly in the structural equations for construction and utilities. In agriculture and manufacturing the investment variables are used to estimate the capital stock figures that are incorporated directly in the respective structural equations.

Services, which include activities such as wholesale trade, retail trade and finance emerges as the largest sector in the economy. It is followed by government, also a services sector. Agriculture is the largest of the goods producing sectors, followed by construction and manufacturing. Tourism is relatively insignificant. In 1974, tourism value added of 14 million dollars accounted for less than 4 percent of GPP.

Various measures of physical output were not found to be statistically significant in explaining value added in fishery, agriculture and manufacturing and are not included in the structural equations. Another interesting feature is that capital stock in agriculture and capital stock in manufacturing are not significant statistically in explaining agriculture and manufacturing value added. This finding is consistent with the fact that value added in these two particular sectors appears very sensitive to changes in output prices. These results suggest investment in these two sectors is not directed towards expanding total physical output since the return to capital would be primarily a function of changes in prices rather than of increases in total production.

Virtually all of the growth in tourism value added can be explained by factors external to the Island, namely by a long term time trend and by changes in Gross National Product. These two variables suggest that tourist spending on the Island rose because of such long term national trends as the growth in personal incomes; the increased propensity to travel; and greater personal mobility. A different picture emerges in the construction sector where the principal factors can be manipulated directly by the provincial government through its own capital spending programs and its influence on the housing market. However, the government's actions can also exercise a destabilizing effect on this industry because the public sector as a whole accounts for a substantial proportion of all activity in the sector.

EMPLOYMENT BLOCK



STRUCTURAL EQUATIONS

				$\bar{R}^2$	DW	SER
(6)	EMQK	≡	EMQA + EMQM + EMQF + EMQT + EMQG + EMQS			
(21)	EMQA	=	11149 + .03 VAMA - 3528 WSAA (.18) (.67) (-2.54)	.59	1.91	814
(22)	EMQM	=	2764 + .20 VAMM - 2877 WSAM + 27 DUM1 (13.86) (3.57) (-4.11) (4.10)	.66	2.90	106
(23)	EMQC	=	1152 + .07 VAMC (2.28) (3.98)	.65	2.99	592
(24)	EMQF	=	612 - .03 VAMF + .07 KCQF (2.31) (-3.42) (3.57)	.60	1.44	35
(25)	EMQT	=	209 + .08 VAMT + 70 DUM 1 (5.45) (16.14) (10.72)	.99	2.42	13
(26)	EMQG	=	4017 + .02 XPMK + 13.37 DUM1 (13.71) (4.79) (.25)	.99	3.29	94
(27)	EMQS	=	9784 + .04 VAMS (6.41) (3.52)	.59	1.72	1040

VARIABLES

DUM I	.	time trend
EMQA	.	employment in P.E.I. agriculture
EMQC	.	employment in P.E.I. construction
EMQF	.	employment in P.E.I. fishery
EMQG	.	employment in municipal, provincial and federal governments in P.E.I.
EMQK	.	total employment in P.E.I.
EMQM	.	employment in P.E.I. manufacturing
EMQS	.	employment in P.E.I. services
EMQT	.	employment in P.E.I. tourism
EMQF	.	total number of small powered craft
VAMA	.	value added in P.E.I. agriculture, thousands of dollars
VAMC	.	value added in P.E.I. construction, thousands of dollars
VAMF	.	value added in P.E.I. fishery, thousands of dollars
VAMM	.	value added in P.E.I. manufacturing, thousands of dollars
VAMS	.	value added in P.E.I. services, thousands of dollars
VAMT	.	value added in P.E.I. tourism, thousands of dollars
WSAA	.	average hourly wage in agriculture
WSAM	.	average hourly wage in manufacturing
XPMK	.	total tourist expenditure, thousands of dollars

EMPLOYMENT BLOCK

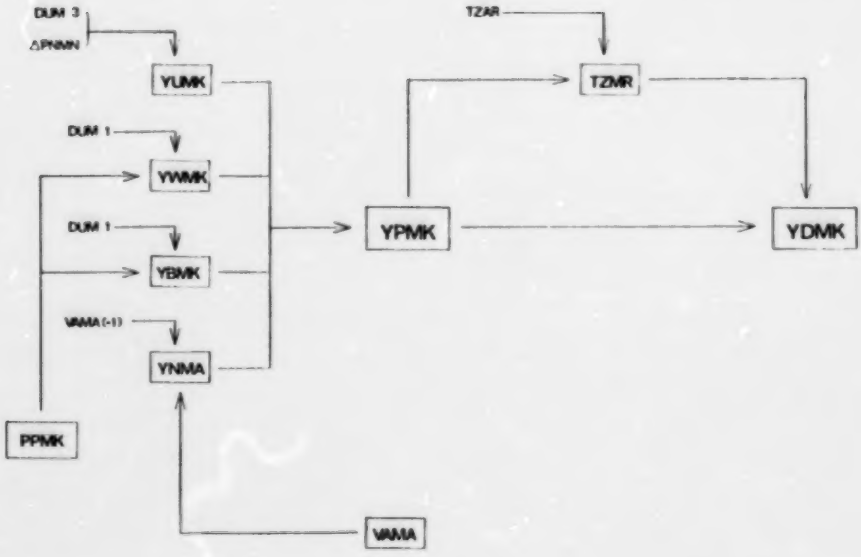
Total employment in the P.E.I. economy is disaggregated into seven sectors. No data were available for utilities: employment in this sector has been included in the services sector. The latter is the residual or difference between total employment and the number of employees in the other six sectors. Serious problems were encountered in measuring P.E.I. employment by sector because the official sampling techniques have been designed for larger populations with a higher degree of occupational specialization. The data are only available on an annual basis and therefore provide no indication of seasonal fluctuations in any sector or throughout the economy as a whole. Considering the central importance of employment policy to long term development planning, we recommend that further efforts be made to collect accurate, detailed information at regular intervals throughout the year.

In four of the structural equations, the coefficient of value added was statistically significant and positively related to changes in employment. The response was strongest in manufacturing where a $1 million increase in value added would lead — *according to the structural formulation only* — to an increase of 200 jobs. In other sectors the response ranged from an additional 40 jobs in services to 80 in tourism. It is worth noting, however, from our previous analysis of the product block that this increase in manufacturing value added would probably occur as a result of price changes rather than from an increase in physical output. The coefficient of value added in agriculture is not significant in explaining changes in employment in this sector. In fishery the coefficient is significant but negative, thereby indicating that an increase in value added leads to a decline in total employment in that sector.* Another interesting feature is the negative relationship between wage rates in agriculture and manufacturing and the number of people employed in each of these sectors. An increase of $1.00 in agricultural wages would lead — all other factors remaining constant — to a drop of 3,528 in agricultural employment. The corresponding decline in manufacturing would be 2,877 jobs. Since the labor force in these sectors is relatively unskilled, the model appears to imply that an increase in wages, without a compensating rise in productivity will result in a substitution of capital for labor. Development plan policies aimed at lowering the cost of capital might conceivably lead to a decline in total employment rather than an increase in total production, particularly if, as noted earlier, the return to capital depends primarily on prices rather than physical output.

---

* The other explanatory variable in this equation is Powered Fishing Craft, a proxy variable for the number of lobster licenses.

INCOME BLOCK



STRUCTURAL EQUATIONS

		$\bar{R}^2$	DW	SER
(1)	YPMK ≡ YWMK + YBMK + YNMA + YUMK			
(2)	YDMK ≡ YPMK − TZMR			
(13)	TZMR = −24281 + 18600 TZAR + .14 YPMK (5.14) (3.53) (13.29)	.99	1.73	1240
(9)	YWMK = −21019 + .37 PPMK + 3993 DUM1 (−3.93) (6.96) (2.50)	.99	2.71	3380
(10)	YBMK = 1419 + .10 PPMK + 1030 DUM1 (1.61) (11.33) (3.92)	.99	3.06	556
(11)	YNMA = 7588 + .83 VAMA − .72 VAMA (−1) (1.85) (5.77) (−3.43)	.80	2.98	3540
(12)	YUMK = −13505 + .00067 PNMN + 6131 DUM3 (6.45) (24.85) (4.38)	.99	2.96	1000

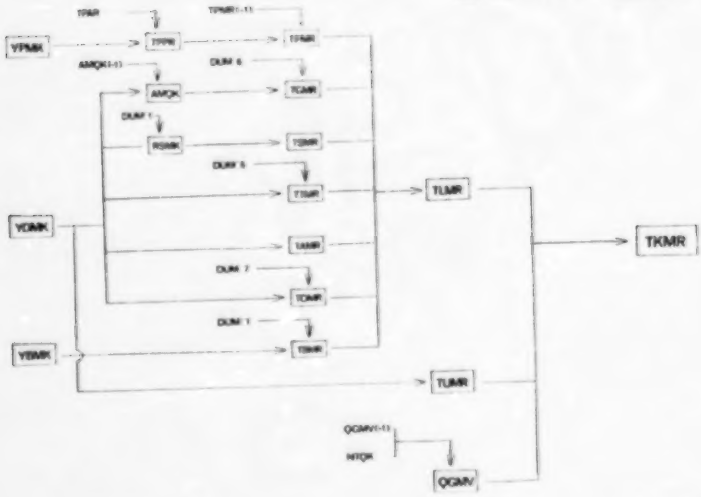
VARIABLES

DUM 1 . time trend
DUM 3 . dummy variable representing 1971 revisions in Unemployment Insurance legislation
PNMN . gross national product, thousands of dollars
PPMK . gross provincial product, thousands of dollars
TZAR . average personal tax rate
TZMR . total direct taxes and other contributions, thousands of dollars
VAMA . value added in agriculture, thousands of dollars
YBMK . total income from interest and from non-farm unincorporated business
YDMK . total disposable income, thousands of dollars
YNMA . total net farm income, thousands of dollars
YPMK . total personal income, thousands of dollars
YUMK . total personal income transfers, thousands of dollars
YWMK . total wage and salary income, thousands of dollars

INCOME BLOCK

The income block contains four equations that comprise the five major sources of personal income: wage and salary income; interest, dividend and unincorporated non-farm income (business income); net farm income; and income from personal transfers. As of 1974, the largest component was income from wages and salaries (53%) followed by income from transfer payments (24%), business income (16%) and net farm income (6%). The proportion of personal income attributable to each of these sources has not changed substantially over the past five years.

Both wage and business income were found to be statistically significant and positively related to Gross Provincial Product. Net farm income is positively related to agriculture value added in the current year and negatively related to agriculture value added in the previous year. Transfer payments are explained by changes in Gross National Product. In addition, a dummy variable representing the revisions made in 1971 to the Unemployment Insurance Act was found to be statistically significant; its structural coefficient suggests that these changes were responsible for an additional six million dollar inflow annually of personal income transfers to P.E.I.



STRUCTURAL EQUATIONS

			$\bar{R}^2$	DW	SER
(8)	TKMR	≡ TLMR + TUMR + QGMV			
(7)	TLMR	≡ TSMR + TNMR + TPMR + TMBR + TGMR + TTMR + TAMR + TDMR			
(29)	TSMR	= -13565 + .10 RSMK + 122584 TSAR (-11.19) (8.22) (4.03)	.98	1.99	666
(28)	RSMK	= 49150 + .62 YDMK - 2623 DUM1 (4.93) (5.11) (.94)	.97	2.41	5440
(30)	TNMR	= 713 + .94 TNMR (-1) - 3967 DUM 4 (.71) (4.41) (-4.00)	.73	2.12	809
(31)	TPMR	= -2134 + 2342 TPPR + .68 TPMR (-1) (-3.98) (4.19) (5.00)	.99	1.05	238
(32)	TPPR	= -.65 + .000004 YPMK + 4.75 TPAR (-2.06) (4.68) (2.95)	.97	2.86	.089
(33)	TBMR	= -116 + .02 YBMK + 89 DUM1 (-.60) (.86) (1.13)	.92	3.03	127
(34)	TGMR	= -5457 + .29 AMQK + 280 DUM 6 (-4.21) (8.80) (.91)	.92	0.97	401
(35)	AMQK	= 17470 + .05 YDMK + .30 AMQK (-1) (2.71) (3.36) (1.19)	.99	2.02	483
(36)	TTMR	= -273 + .006 YDMK + 186 DUM 5 (-2.23) (10.62) (1.99)	.92	1.63	100
(37)	TAMR	= 208 + .004 YDMK (3.12) (11.36)	.94	2.65	58
(38)	TDMR	= -263 + .003 YDMK + 739 DUM 7 (-3.07) (5.06) (11.04)	.99	2.99	61
(39)	TUMR	= -5957 + .001 YDMK + 1463 DUM 1 (11.01) (-.19) (9.63)	.99	2.25	296
(40)	QGMV	= -505110 + .35 QGMV (-1) + 4.79 NTQK (-2.54) (.98) (2.54)	.96	2.03	3760

VARIABLES

AMQK . total number of vehicles registered in P.E.I.
DUM 1 . time trend
DUM 4 . dummy variable representing change in property tax rate
DUM 5 . dummy variable representing change in tobacco tax rate
DUM 6 . dummy variable representing change in gasoline tax rate
DUM 7 . dummy variable representing change in tax base
NTQK . total P.E.I. population
QGMV . P.E.I. provincial revenue from Canada, thousands of dollars
RSMK . P.E.I. retail sales, thousands of dollars
TAMR . alcoholic beverages tax revenue, thousands of dollars
TBMR . business tax revenue, thousands of dollars
TGMR . gasoline tax revenue, thousands of dollars
THMR . property tax revenue, thousands of dollars
TKMR . total provincial government revenue, thousands of dollars
TLMR . total provincial tax revenue, thousands of dollars
TOMR . miscellaneous tax revenue, thousands of dollars
TPAR . P.E.I. personal income tax rate
TPMR . provincial personal income tax revenue, thousands of dollars
TPPR . effective personal tax rate
TSAR . sales tax revenue
TSMR . sales tax revenue, thousands of dollars
TTMR . tobacco tax revenue, thousands of dollars
TUMR . revenue from licenses and fees, thousands of dollars
TZAR . average personal tax rate
TZAR . total direct taxes, thousands of dollars
YBMK . total income from interest, dividends, and unincorporated non-farm business, thousands of dollars
YDMK . total disposable income, thousands of dollars
TPMK . total personal income, thousands of dollars

PROVINCIAL REVENUE BLOCK

The revenue block consists of two definitional and thirteen behavioral equations that together account for revenues from eight provincial taxes, transfers from the federal government and income from licenses and fees. Two of the behavioral equations explain changes in retail sales and vehicle registrations that are subsequently used to determine the revenues from sales tax and gasoline tax respectively. Provincial population is significant in explaining revenue transfers from the federal government; the variable reflects the importance of the per capita formulae used in the Equalization and Cost Sharing Agreements between the Province and the Federal Government. With the exception of property and business taxes, disposable income was used as a variable to explain changes in revenue from indirect taxes. Personal income tax, on the other hand, was found to be a function of the effective personal tax rate and of changes in personal income. The "buoyancy" or responsiveness of the tax structure to the growth of personal and disposable income is examined in the next chapter which also contains our analysis of impact multipliers.

IV. IMPACT ANALYSIS

An important feature of the model are the impact multipliers; they are presented in matrix form on the inside back cover. The impact multipliers enable policy makers to simulate various policy options by estimating the effects of adjustments in such exogenous variables as prices and investment on the model's endogenous variables (employment, incomes, etc.).

The reduced form matrix is obtained by transforming the structural equations so that each of the model's endogenous variables is now expressed as a linear function of the exogenous variables only in the model. In this form, the model can measure the effect of a change in any one or all of the exogenous variables on any one or all of the endogenous variables.

The exogenous and lagged endogenous variables are listed in the left hand column of the matrix. The endogenous variables are listed across the top of the matrix. By tracing any given row across the matrix, we can determine the impact of that particular exogenous variable on the endogenous variables in the model. For example, the variable OTJM, the manufacturing price index, affects most of the endogenous variables in the model. In the specific case of manufacturing employment (EMQM), the coefficient 15.2 signifies that a one percentage point increase in manufacturing prices will raise employment by approximately 15 jobs. The effects of changes in such variables as tourist expenditures, that are endogenous to the model, on other endogenous variables such as employment can be measured through simulation methods.

The reliability of the reduced form can be checked by comparing the actual values to those simulated by the model. An important statistic for gauging the model's tracking abilities is the Root Mean Square (RMS) percentage error. In virtually all cases it is below 10%, thereby indicating that the values generated by the model are close to the actual figures. The actual and simulated values for the model's eight definition and thirty-two behavioral equations are presented in graphical form in Appendix C.

The sensitivity of the P.E.I. economy to external price changes can be illustrated by tracing the impact of changes in agricultural and manufacturing prices on output, income, employment and government revenue. A rise of one percentage point in the price index for farm products will increase Gross Provincial Product by $219,744; a similar change in the wholesale price index will raise GPP by $86,119. This result suggests that effective marketing of farm products as well as changes in national and international prices will have a substantial impact on incomes and employment throughout the provincial economy.

Another significant observation is the limited capability of the provincial government to alter total output and employment in the short term. Two variables, housing and government capital spending, appear to be available for this purpose. A one million dollar increase in housing investment will lead to a growth of $555,241 in Gross Provincial Product. A comparable increase in government capital spending will raise GPP by $396,600. Some of the more pertinent results of the impact analysis are summarized in the attached table.

IMPACT OF CHANGES IN KEY VARIABLES ON THE PROVINCIAL ECONOMY

Exogenous Variables	Endogenous Variables: Gross Provincial Product ($)	Employment (number)	General Tax Revenue ($)
Agricultural Price Index by one-percentage point	219,700	7	20,865
Wholesale Price Index (manufactured goods)	86,120	15	3,660
Investment expenditures on housing by $1.0 Million	555,240	37	23,640
Investment expenditures on institutional services & government departments by $1.0 Million	396,600	26	16,880
Δ GNP by $1.0 Billion	1,890,000	7	65,275
Δ in Δ GNP by $1.0 Billion	3,399,000	25	14,470
Trend element	5,800,000	635	308,150

The impact analysis provides further evidence* of a narrow, inelastic tax base that will create serious financial difficulties for the provincial government. The tax sector of the model is not very responsive to changes in the exogenous variables. For example, a one percentage point increase in the agricultural price index will only generate an additional $20,865 in general tax revenues. A one billion dollar rise in GNP will increase provincial tax revenues by $65,928. The trend element accounts for an average annual growth of $308,158 in tax revenues. A one million dollar increase in each of the investment variables will result in a total increase in revenues of $43,906. The implication of these figures is that the provincial government will face a growing gap between revenues and expenditures unless its own revenues are supplemented by major increases in federal transfers, or the growth in ordinary and development expenditures is cut substantially.

---

* An earlier study revealed that the income elasticity of expenditures was greater than the income elasticy of revenues. See Nagarajan, P. *An Econometric Model of the P.E.I. Tax Sector*. Pp. 6-7.

V. POLICY IMPLICATIONS

Our analysis raises a number of serious questions concerning Canada's regional development policy, as articulated in the Regional Development Incentives Act, and the Prince Edward Island Development Plan. Both of these measures, as well as the General Development Agreements signed with other provinces, are based on the premise that Canada' poorer regions suffer from a shortage of capital necessary to generate output, income and employment. The private sector is unwilling to invest in poorer regions because of the attendant risks and low returns relative to investment in Canada's major manufacturing centres. Hence, private investment has been subsidized through development grants to individual firms and through such general infrastructure as industrial parks, improved roads, etc.

We note however, in the case of P.E.I. that most of the growth in employment has occured in services, a sector that is not stressed in the Development Plan. Secondary manufacturing remains insignificant in terms of value added, total output and employment. We feel that this trend is not temporary or accidental, but rather indicative of the behavior of the private sector in such economies as P.E.I., that are heavily dependent on primary production and extremely vulnerable to major fluctuations in international prices. We contend that many producers will attempt to minimize risk, even at the expense of reducing total potential gains. They are prepared to produce less in order to avoid the possibility of being "over extended" in the event of a sudden drop in output prices. This contention would explain why we, as well as the 1971 model found that capital stock investment and physical output were not significant in determining value added in manufacturing or agriculture. Agricultural output, for example, is the same as it was in 1961.

Capital investment cannot be varied in the short term, in the event of a sudden drop in prices. Inputs of labor, however, can be changed relatively quickly in such unsophisticated industries as fish and food processing. A similar substitution of capital for labor might ensue if there were a rapid rise in wages. This behavior would explain the strong negative relationships that we found between agricultural and manufacturing employment, and the wage rates in these sectors.

Development incentives would not alter this behavior, since producers will still be faced with the uncertainty of externally determined price changes. Incentive grants would add to total profits, without significant increases in output and employment. In the most extreme case, grants will be used to substitute capital for labor: in other words, the grant will be instrumental in *reducing* the growth in employment.

Our findings are confirmed to a considerable extent by trends in investment and employment in Atlantic Canada as a whole. Between 1966 and 1974, investment grew at the healthy rate of 11% per annum. The compounded growth in employment in secondary industry was a disappointing 1.7% per annum. Most of the new jobs were created in the services sector of the economy.

In our view this situation will not change until the underlying cause, namely the uncertainty posed by the market for primary and processed products is removed. Such remedial action, for obvious reasons, cannot be undertaken by any provincial government on its own. As an interim measure, however, government can conduct a detailed analysis of the relationship in various industries between investment on one hand and employment and output on the other.

Perhaps as a reaction to the disappointingly slow growth in secondary industry, the provincial and federal governments have been taking positive steps to encourage "tertiary" or service industries in the Atlantic Region. A principal justification has been ad-

vanced in the form of the "urban service centre", a concept which argues that development can be hastened by the establishment of "growth poles" in the region. The latter are urban centres that use produce and personnel in the surrounding area in return for a range of financial, technical, and professional services formerly provided in Montreal, Toronto and Boston. Most recently, Ottawa has been added to this list of cities: the federal government is instituting a policy of decentralizing federal agencies and Departments, with priority in relocation being given to areas with low incomes and high unemployment.

We noted that most of the growth and employment in P.E.I. since 1971 has taken place in service industries. The three principal non-goods producing sectors: tourism, government, and services (finance, retail trade, wholesale trade) accounted for two-thirds of all employment in 1974. This new policy would confirm the structural shift in the economy directly to services, rather than to secondary manufacturing as originally envisaged in the Development Plan. While growth in these sectors has offset the decline in agricultural and fishery employment, we have little evidence to indicate whether the people leaving primary production are the same ones accepting employment in the service sectors. These and other related issues, such as the size and effect of seasonal fluctuations in employment; the role of secondary earners; and the availability of jobs for young Prince Edward Islanders would require detailed and systematic study, perhaps in conjunction with the previously recommended investigation of capital investment.

We feel that a thorough examination of these questions merits high priority since the answers also bear directly upon the appropriateness and effectiveness of the policies and programs for regional development in this country.

Analysis of the tax sector shows that total provincial tax revenues will be increasing, but at a steadily decreasing rate if no attempt is made to alter the tax base or the tax rate. The scope for enlarging P.E.I's narrow tax base is limited in the short term because the economy lacks a significant secondary manufacturing sector. Since the yield from the present tax mix depends upon movements in the provincial and national economies, a change in tax rates will not necessarily bring about the desired increase in revenues. In the absence of substantial transfers from the federal government the province will have to reduce the growth in ordinary as well as development expenditures in the years ahead.

It is noteworthy that the problems posed by an inelastic tax structure and by unstable output prices are also characteristic of the economies of many developing nations.

From the inception of the Development Plan, marketing services have been encouraged in order to support investments in primary production and manufacturing. However, the posture has been essentially passive; marketing advice and research are available to individual entrepreneurs upon request. Our analysis suggests that a much more aggressive and direct involvement in the sale of products is justified because changes in prices have a substantial impact on the incomes and employment prospects of many Prince Edward Islanders. It is also evident from our analysis that investments in agriculture and manufacturing have not generated the anticipated response in output and jobs, partly because of the uncertainties posed by fluctuating prices. Substantially greater subsidies to private investors would be needed if they are to be attracted to P.E.I. However, if the anticipated constraint on tax revenues precludes this option, government may have to create its own enterprises in order to change the structure of the provincial economy.

References:

A. 1. STATISTICAL SOURCES P.E.I.

Public Accounts 1960/61 to 1974/75. Queens Printer, Charlottetown.
Annual Statistical Review, 1974-1975. Queen's Printer, Charlottetown.
Department of Tourism. Tourism Employment Survey, Queen's Printer, Charlottetown, P.E.I.

2. STATISTICS CANADA

Catalogue No. 13-201	System of National Accounts - National Income and Expenditure Accounts
Catalogue No. 21-003	Quarterly Bulletin of Agricultural Statistics
Catalogue No. 21-201	Farm Cash Receipts
Catalogue No. 21-202	Farm Net Income
Catalogue No. 21-203	Index of Farm Production
Catalogue No. 24-203	Fishery Statistics. P.E.I.
Catalogue No. 31-203	Gen. Review of Manufacturing Industries of Canada. Volume I, Industries by Province.
Catalogue No. 53-219	The Motor Vehicle, Part III. Registrations
Catalogue No. 61-202	Survey of Production. System of National Accounts. Domestic Product by Industry
Catalogue No. 61-205	Private and Public Investment in Canada. Outlook and Regional Estimates
Catalogue No. 63-005	Retail Trade
Catalogue No. 63-517	Retail Trade 1961-66
Catalogue No. 63-519	Retail Trade. Revisions to 1966-1970 Post-censal Estimates
Catalogue No. 71-001	The Labour Force
Catalogue No. 72-002	Employment, Earnings and Hours
Catalogue No. 72-004	Federal Government Employment
Catalogue No. 72-007	Provincial Government Employment
Catalogue No. 72-008	Estimates of Employees by Province and Industry (to 1970)
Catalogue No. 72-009	Local Government Employment

B. OTHER REFERENCES

Haronitis, D.	"An Econometric Model for the Ontario Economy." *Ontario Economic Review*. Special Supplement. MMarch 1971.
Young, Geoffrey	*A Critique of Some Regional Econometric Models*. Mimeograph. September, 1972.
Maxwell, T.	"Assessing the Macroeconomic Models in Policy Analysis". *Bank of Canada Review*. May 1976.
Nagarajan, P.	*An Econometric Model of the P.E.I. Tax Sector*. P.E.I. studies in Economics. No. 5. UPEI. November 1975.
Schwartz, F.	*An Econometric Model of P.E.I.* Office of the Economic Advisor. Charlottetown. P.E.I. January 1972.
Fine, J. C and Nagarajan, P.	*The Impact of Unemployment Insurance on the Economy of Prince Edward Island*. P.E.I. Studies in Economics. No. 6. UPEI. November 1976.
Christ, C. F.	*Econometric Models and Methods*, New York. John Wiley and Sons, Inc. 1966.

APPENDIX A: MODEL VARIABLES

AMQK — Total Number of Vehicles Registered in P.E.I.

DUM 1 — Dummy variable representing time trend

DUM 3 — Dummy variable represenng 1971 revisions in Unemployment Insurance legislation

DUM 4 — Dummy variable representing change in property tax rate

DUM 5 — Dummy variable representing change in tobacco tax rate

DUM 6 — Dummy variable representing change in gasoline tax rate

DUM 7 — Dummy variable representing change in tax base

EMQA — Number of people employed in P.E.I. agriculture

EMQC — Number of people employed in P.E.I. construction

EMQF — Number of full-time equivalent fishermen in P.E.I. calculated according to formula in Copes (1973) report

EMQG — Total number of municipal, provincial and federal government employees in P.E.I.

EMQK — Total employment in P.E.I.

EMQM — Total employment in P.E.I. manufacturing as estimated by annual census of manufacturers

EMQS — Total number of people employed in services (eshmated as residual between total employment and aggregate of the other sectors)

EMQT — Number of full time employees in tourism sector, as estimated from Tourism Department surveys

ITMA — Investment in Agriculture calculated as a proportion of total investment in primary industry and construction, thousands of dollars

ITMG — P.E.I. investment in institutional services and government departments, thousands of dollars

ITMM — P.E.I. investment in manufacturing, thousands of dollars

ITMU — P.E.I. investment in utilities, thousands of dollars

ITMH — P.E.I. investment in housing, thousands of dollars

KCQF — Total number of powered fishing craft in P.E.I.

KSMA — P.E.I. capital stock in agriculture, thousands of dollars

KSMM — P.E.I. capital stock in manufacturing, thousands of dollars

NTQK — P.E.I. population

OMAF — Average price per pound of molluscs for P.E.I.

OPJA — Eastern Canada Agricultural Price Index, 1961 equals 100

OTJM — Wholesale Price Index for all manufactured goods, Canada, 1935-39 equals 100

PNMN — Gross National Product for Canada, thousands of dollars

PPMK — P.E.I. Gross Provincial Product, thousands of dollars

QGMV — P.E.I. provincial revenues from Canada, thousands of dollars

RSMK — P.E.I. retail sales, thousands of dollars

TAMR — Alcoholic Beverages tax revenue, thousands of dollars

TBMR — All business tax revenue, thousands of dollars

TGMR — Gasoline tax revenue, thousands of dollars

THMR — Property tax revenue, thousands of dollars

TKMR — Total revenue of P.E.I. Government from own taxation, other revenue sources, and federal government, thousands of dollars

TLMR — Total general tax revenue of provincial government, thousands of dollars
TOMR — Provincial revenue from miscellaneous sources, thousands of dollars
TPAR — Personal income tax rate for P.E.I., expressed as percentage of federal tax
TPMR — Provincial personal income tax revenue, thousands of dollars
TPPR — Effective rate of provincial personal income tax calculated as total Provincial income tax divided by total personal income.
TSAR — Provincial sales tax rate
TSMR — Sales tax revenue, thousands of dollars
TTMR — Tobacco tax revenue, thousands of dollars
TUMR — Provincial revenue from licenses and fees, thousands of dollars
TZAR — Average personal tax rate
TZMR — Total direct taxes and other contributions, thousands of dollars
VAMA — Census value added in P.E.I. agriculture, thousands of dollars
VAMC — Census value added in P.E.I. construction, thousands of dollars
VAMF — Census value added in P.E.I. fisheries, thousands of dollars
VAMG — Value added in public sector, thousands of dollars, estimated as total salaries of municipal, provincial and federal governments.
VAMM — Census value added in P.E.I. manufacturing, thousands of dollars
VAMS — Value added in service sector, thousands of dollars, estimated as residual between Gross Provincial Product, and aggregated value added of the other sectors.
VAMT — Value added from tourism, thousands of dollars, calculated as proportion (VXPT) of total tourism expenditure (XTMT) remaining in P.E.I.
VAMU — Census value added in P.E.I. utilities, thousands of dollars
VXPT — Proportion of total tourist expenditure going to wages profits and indirect taxes in the tourist sector as estimated in Acres (1969) report
WSAA — Average hourly wages of male farm help, non-boarding, in Maritimes
WSAG — Average salary paid to government employees in P.E.I., thousands of dollars
WSAM — Average hourly wage rate in N.B. manufacturing, dollars
XPMK — P.E.I. provincial government total ordinary expenditure, thousands of dollars
XTMT — Total tourist expenditures, thousands of dollars
YBMK — Total income from dividends and non farm unincorporated business, thousands of dollars
YDMK — P.E.I. personal disposable income, thousands of dollars
YNMA — P.E.I. Net farm income, thousands of dollars
YPMK — P.E.I. personal income, thousands of dollars
YUMK — P.E.I. unearned income, thousands of dollars
YWMK — P.E.I. wages salaries and supplementary income, thousands of dollars

APPENDIX B: COMPUTER FORMULATION OF THE MODEL

MODEL
SYMBOL DECLARATIONS

ENDOGENOUS

AMQK	EMQA	EMQC	EMQF	EMQG	EMQM	EMQS	EMQT	QGMV	RSMK	TAMR
TBMR	TGMR	THMR	TOMR	TPMR	TPPR	TSMR	TTMR	TUMR	TZMR	VAMA
VAMC	VAMF	VAMM	VAMS	VAMR	XTMT	YBMK	YNMA	YUMK	YWMK	

DEFINITION

EMQK	PPMK	TKMR	TLMR	VAMG	VAMT	YDMK	YPMK

EXOGENOUS

DUM1	DUM3	DUM4	DUM5	DUM6	DUM7	ITMG	ITMH	ITMU	KCQF
KSMA	KSMM	NTQK	OMAF	OPJA	PNMN	TPAR	TSAR	TZAR	VXPT
WSAA	WSAG	WSAM	OTJM	XPMK					

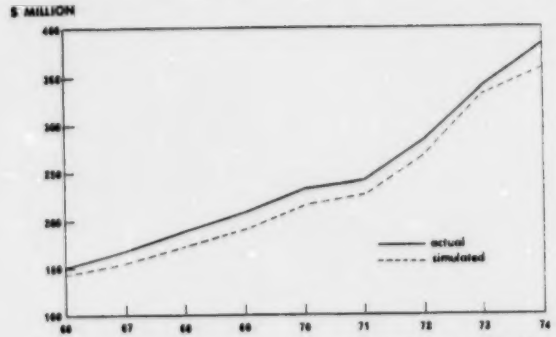
COEFFICIENT

A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22
A23	A24	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34	A35
A36	A37	A38	A39	A40	A9	B10	B11	B12	B13	B14	B15	B16
B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29
B30	B31	B32	B33	B34	B35	B36	B37	B38	B39	B40	B9	C10
C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23
C24	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36
C37	C38	C39	C40	C9	D14	D22						

EQUATIONS

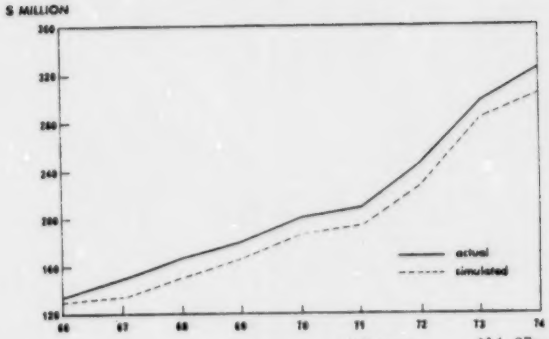
```
 1:   YPMK ≡  YWMK  +  YBMK  +  YNMA  +  YUMK
 2:   YDMK ≡  YPMK  -  TZMR
 3:   VAMT ≡  XTMT*VXPT
 4:   VAMG ≡  EMQG*WSAG
 5:   PPMK ≡  VAMA + VAMM + VAMC + VAMU + VAMF + VAMT + VAMG + VAMS
 6:   EMQK ≡  EMQA + EMQM + EMQC + EMQF + EMQT + EMQG + EMQS
 7:   TLMR ≡  TSMR + THMR + TPMR + TBMR + TGMR + TTMR + TAMR + TOMR
 8:   TKMR ≡  TLMR + TUMR + QGMV
 9:   TWMK =  A9 + B9*PPMK + C9*DUM1
10:   TBMK =  A10 + B10*PPMK + C10*DUM1
11:   YNMA =  A11 + B11*VAMA + C11*VAMA (-1)
12:   YUMK =  A12 + B12*PNMN + C12*DUM3
13:   TZMR =  A13 + B13*TZAR + C13*YPMK
14:   VAMA =  A14 + B14*OPJA + C14*KSMA + D14*DUM1
15:   VAMM =  A15 + B15*KSMM + C15*OTJM
16:   VAMC =  A16 + B16*ITMH + C16*ITMG
17:   VAMU =  A17 + B17*ITMU + C17*DUM1
18:   VAMF =  A18 + B18*VAMF(-1) + C18*OMAF
19:   XTMT =  A19 + B19*DEL(1:PNMN) + C19*DUM1
20:   VAMS =  A20 + B20*YPMK + C20*DUM1
21:   EMQA =  A21 + B21*VAMA + C21*WSAA
22:   EMQM =  A22 + B22*VAMM + C22*WSAM + D22*DUM1
23:   EMQC =  A23 + B23*VAMC
24:   EMQF =  A24 + B24*VAMF + C24*KCQF
25:   EMQT =  A25 + B25*VAMT + C25*DUM1
26:   EMQG =  A26 + B26*XPMK + C26*DUM1
27:   EMQS =  A27 + B27*VAMS
28:   RSMK =  A28 + B28*YDMK + C28*DUM1
29:   TSMR =  A29 + B29*RSMK + C29*TSAR
30:   THMR =  A30 + B30*THMR (-1) + C30*DUM4
31:   TPMR =  A31 + B31*TPPR + C31*TPMR (-1)
32:   TPPR =  A32 + B32*YPMK + C32*TPAR
33:   TBMR =  A33 + B33*YBMK + C33*DUM1
34:   TGMR =  A34 + B34*AMQK + C34*DUM6
35:   AMQK =  A35 + B35*YDMK + C 35*AMQK(-1)
36:   TTMR =  A36 + B36*YDMK + C36*DUM5
37:   TAMR =  A37 + B37*YDMK
38:   TOMR =  A38 + B38*YDMK + C38*DUM7
39:   TUMR =  A39 + B39*YDMK + C39*DUM1
40:   QGMV =  A40 + B40*QGMV (-1) + C40*NTQK
```

1. PERSONAL INCOME



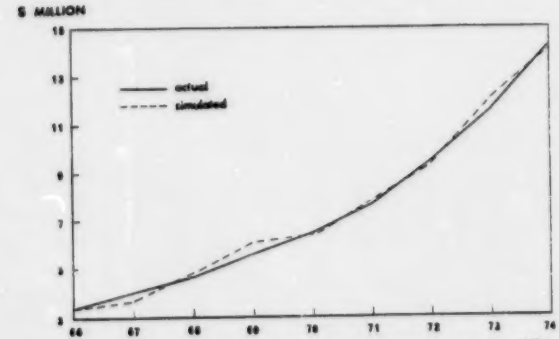
RMS error - $15.08m.
RMS % error - 6.50

2. DISPOSABLE INCOME



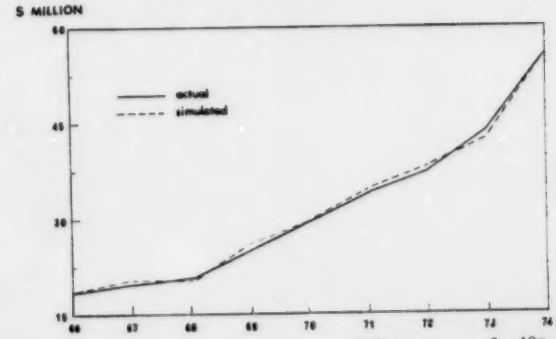
RMS error $14.87m.
RMS % error - 7.32

3. TOURISM VALUE ADDED



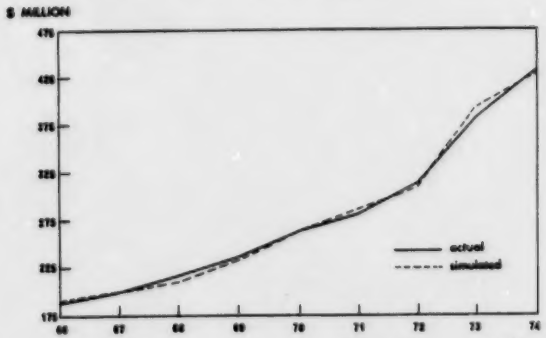
RMS error - $ .27m.
RMS % error - 4.77

4. GOVERNMENT VALUE ADDED



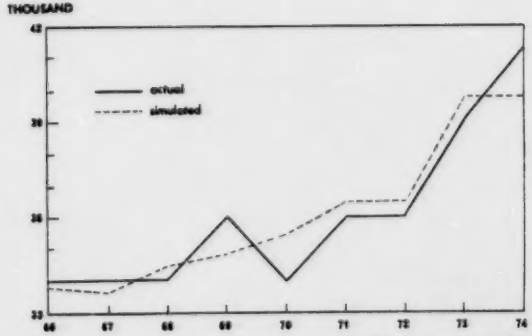
RMS error - $ .40m.
RMS % error - 1.37

5. GROSS PROVINCIAL PRODUCT



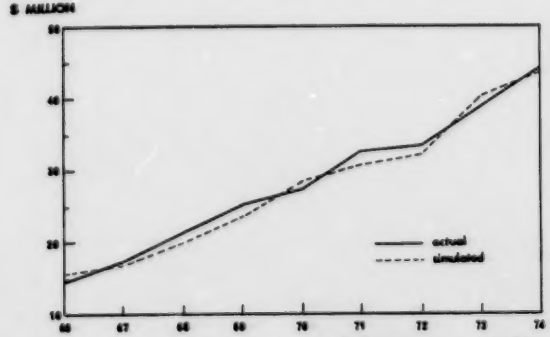
RMS error - $4.90m.
RMS % error - 1.99

6. TOTAL EMPLOYMENT



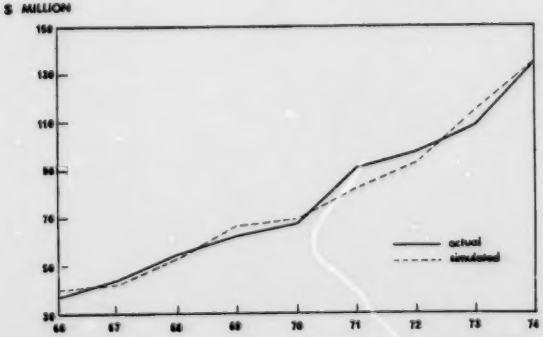
RMS error - $ .89m.
RMS % error - 2.43

7. TOTAL PROVINCIAL TAX REVENUE



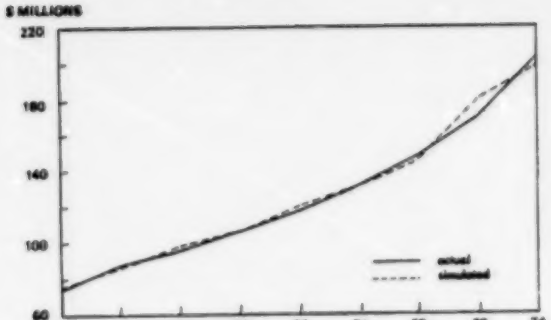
RMS error - $1.27m.
RMS % error - 4.41

8. TOTAL PROVINCIAL REVENUE – ALL SOURCES



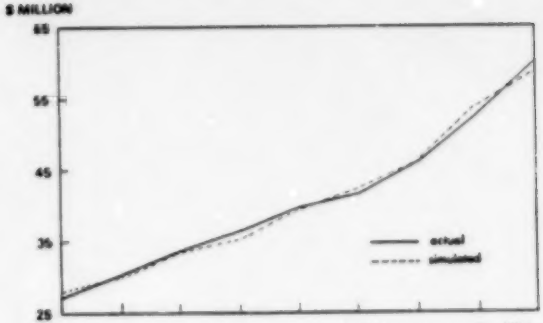
RMS error - $3.77m.
RMS % error - 4.82

9. WAGES AND SALARIES



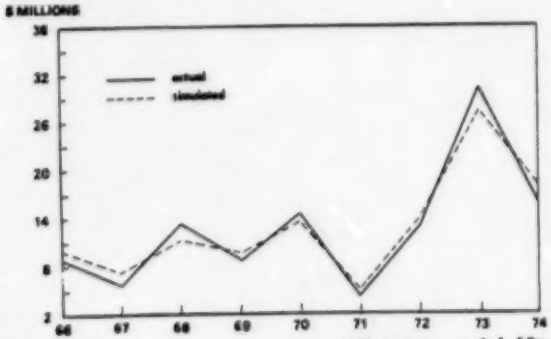
RMS error - $1.42m.
RMS % error - 2.21

10. BUSINESS INCOME



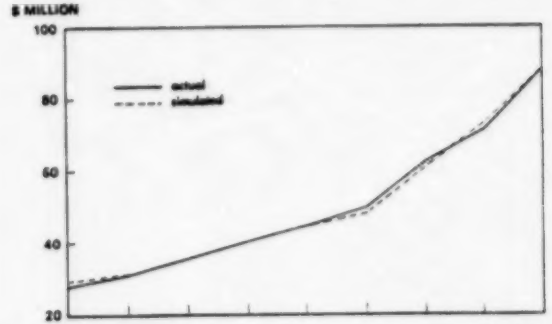
RMS error - $ .72m.
RMS % error - 1.87

11. NET FARM INCOME



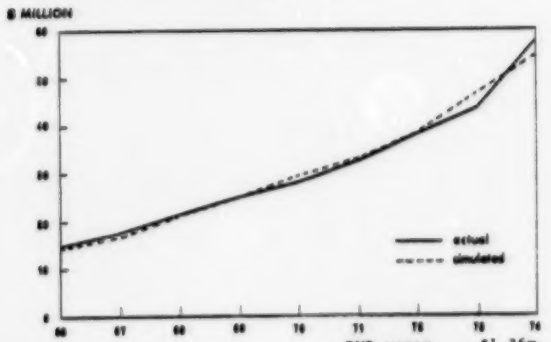
RMS error - $ 1.58m.
RMS % error - 13.64

12. INCOME FROM PERSONAL TRANSFER PAYMENTS

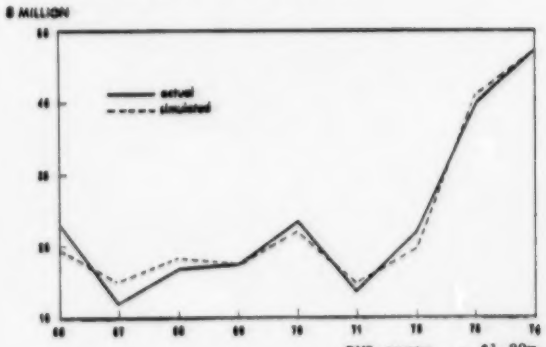


RMS error - $ .82m.
RMS % error - 1.50

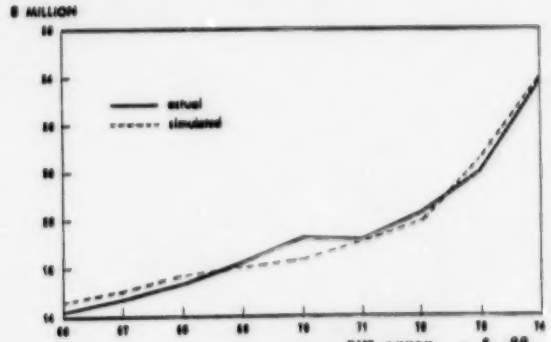
13. TOTAL DIRECT TAXES



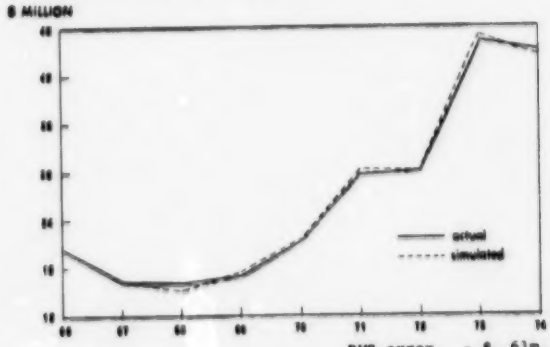
14. AGRICULTURE VALUE ADDED



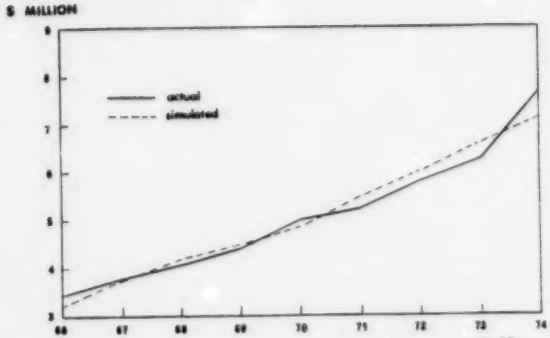
15. MANUFACTURE VALUE ADDED



16. CONSTRUCTION VALUE ADDED

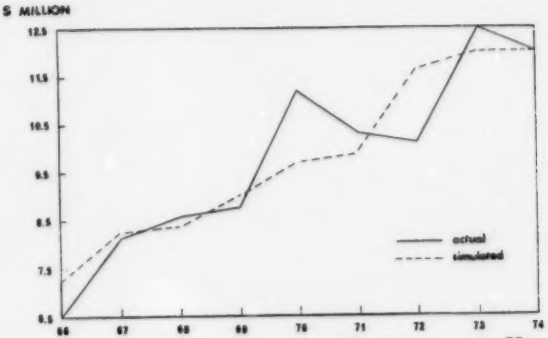


17. UTILITIES VALUE ADDED



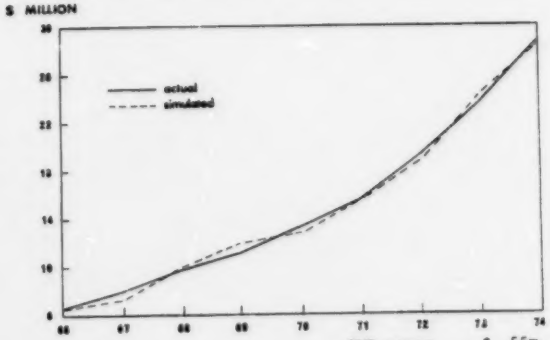
RMS error - $.27m.
RMS % error - 4.40

18. FISHERY VALUE ADDED



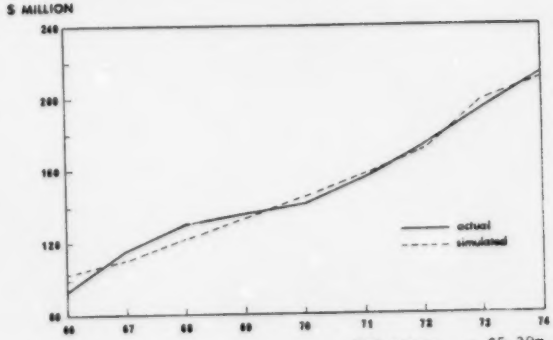
RMS error - $ .77m.
RMS % error - 7.83

19. TOURIST EXPENDITURE



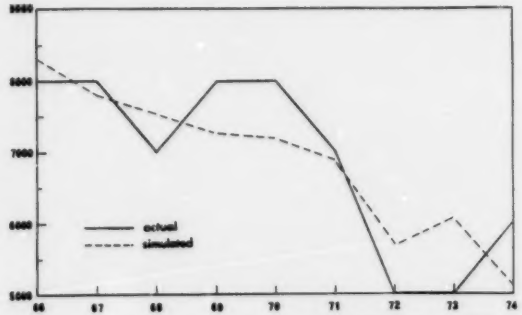
RMS error - $ .55m.
RMS % error - 4.70

20. SERVICES VALUE ADDED



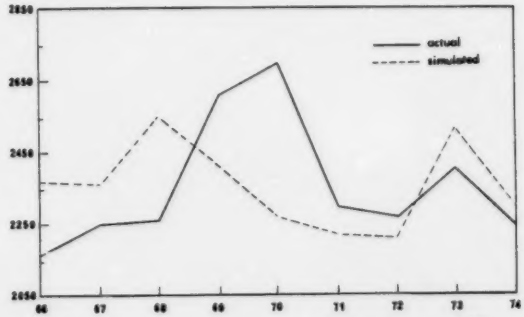
RMS error - $5.39m.
RMS % error - 4.44

21. AGRICULTURE EMPLOYMENT



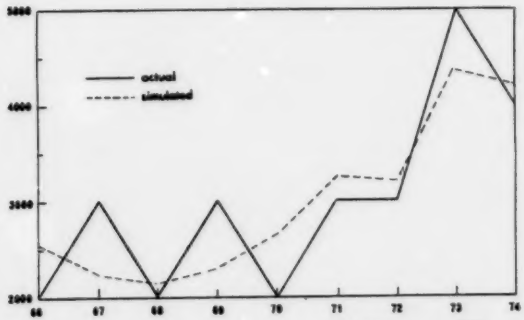
RMS error - 657
RMS % error - 11.71

22. MANUFACTURING EMPLOYMENT



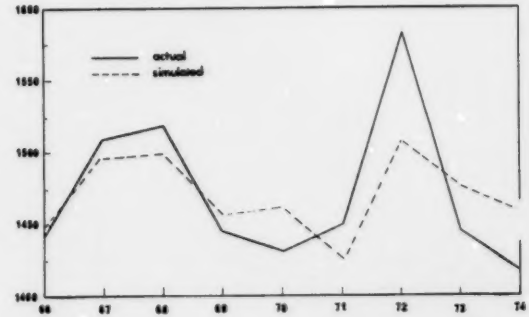
RMS error - 208
RMS % error - 8.40

23. CONSTRUCTION EMPLOYMENT



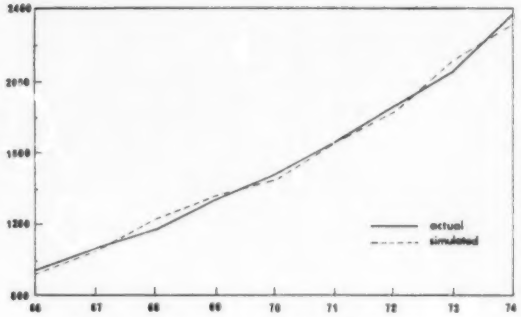
RMS error - 511
RMS % error - 19.27

24. FISHERY EMPLOYMENT



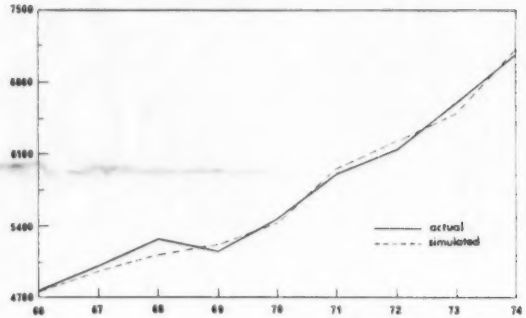
RMS error - 35
RMS % error - 2.31

25. TOURISM EMPLOYMENT



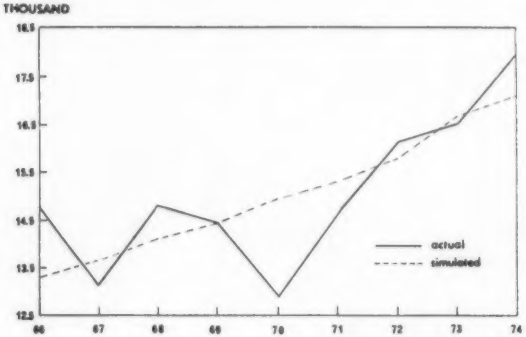
RMS error - 25
RMS % error - 1.57

26. GOVERNMENT EMPLOYMENT



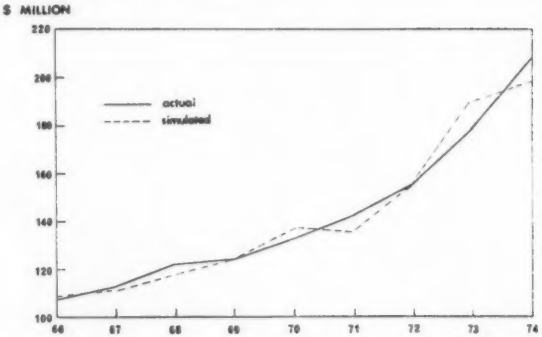
RMS error - 76
RMS % error - 1.37

27. SERVICES EMPLOYMENT



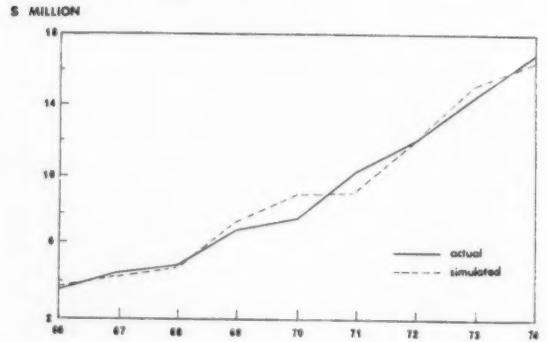
RMS error - 924
RMS % error - 6.73

28. RETAIL SALES



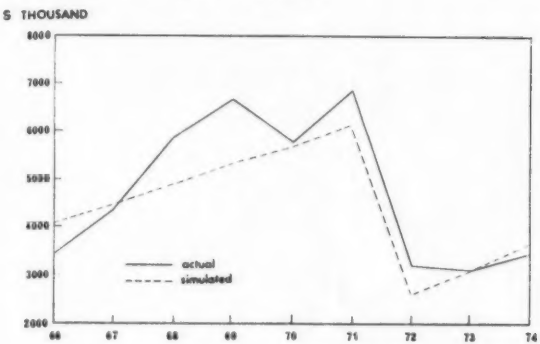
RMS error - $5.39m.
RMS % error - 3.25

29. SALES TAX REVENUE



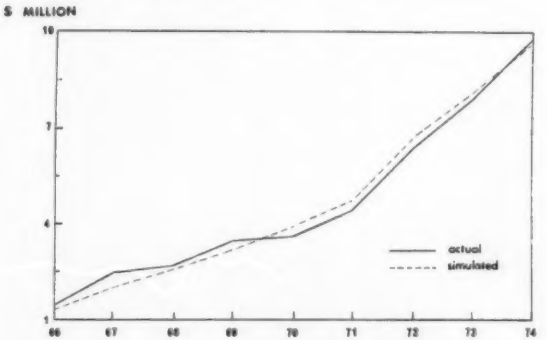
RMS error - $ .72m.
RMS % error - 8.27

30. PROPERTY TAX REVENUE



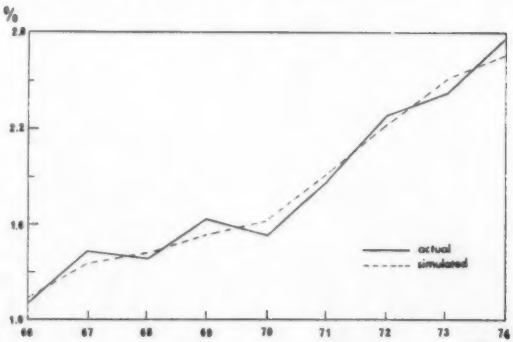
RMS error - $ .66 m.
RMS % error - 12.94

31. PERSONAL INCOME TAX REVENUE



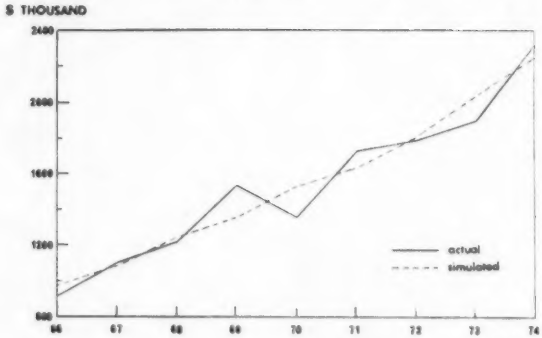
RMS error - $ .30m.
RMS % error - 10.26

32. EFFECTIVE PERSONAL TAX RATE



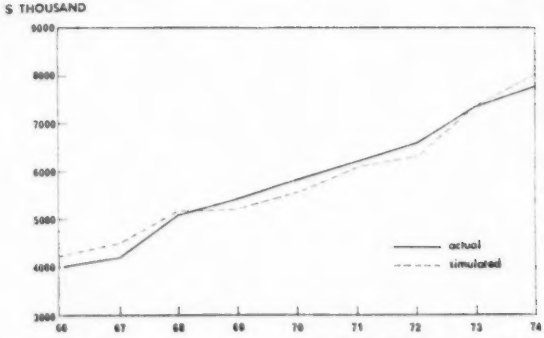
RMS error - .08%
RMS % error - 4.59

33. BUSINESS TAX REVENUE



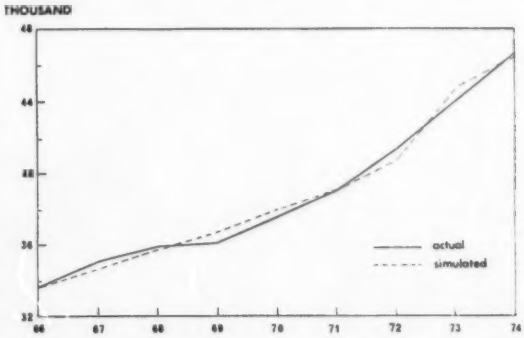
RMS error - $ .11m.
RMS % error - 6.99

34. GASOLINE TAX REVENUE



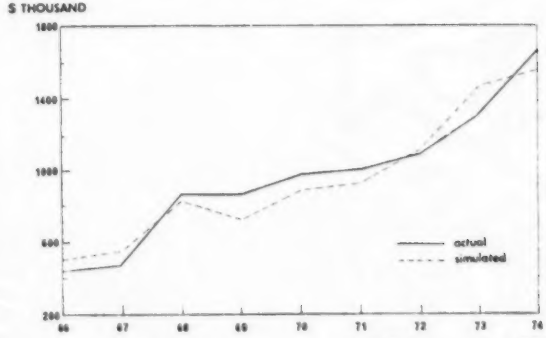
RMS error - $ .24m.
RMS % error - 4.87

35. VEHICLE REGISTRATIONS



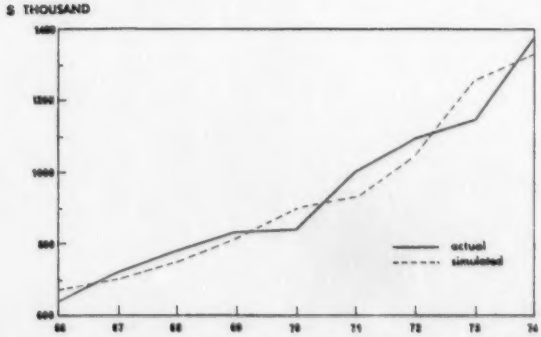
RMS error - .40m.
RMS % error - 1.04

36. TOBACCO TAX REVENUE



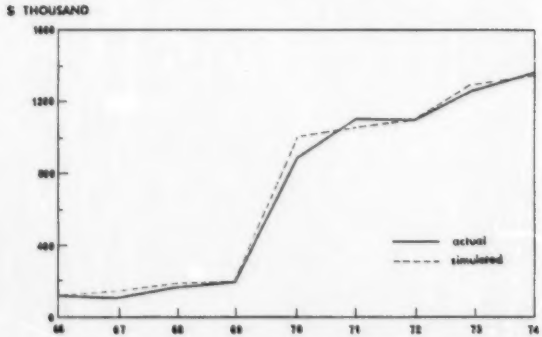
RMS error - $ .096m.
RMS % error - 13.25

37. ALCOHOL TAX REVENUE



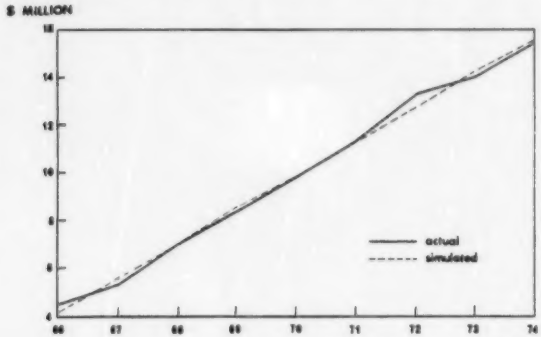
RMS error - $ .59m.
RMS % error - 6.03

38. MISCELLANEOUS TAX REVENUE



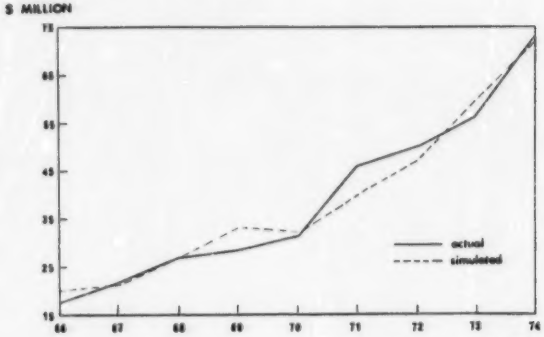
RMS error - $ .05m.
RMS % error - 5.84

39. REVENUE FROM FEES AND LICENSES



RMS error - $ .24m.
RMS % error - 3.71

40. FEDERAL TRANSFERS



RMS error - $2.97m.
RMS % error - 8.25

APPENDIX D Reduced Form Matrix